ENERGOPTIONS

OVERVIEW PAPER

REMOTE COMMUNITIES

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1. INTRODUCTION

Two end-uses - space heating and electricity - account for the vast majority of energy expenditures in remote communities. Although some variations exist between regions, nationally, these two end-uses account for approximately 80-85% of total remote community energy consumption. Space heating accounts for approximately 65-70% of this consumption and diesel power generation accounts for the remaining 30-35%.

Space heating costs are extremely high due to the severe climatic conditions and the high cost of fuel oil. In some cases, all fuel oil supplies must be flown in, resulting in on-site costs which are 2-3 times higher than in southern communities. In some of the smaller and more isolated remote communities, this figure may be 5 to 10 times higher.

Diesel-generated electricity costs may exceed 50¢/kWh -- more than 10 times those of southern communities. This reflects not only the high cost of delivered fuels but also higher maintenance costs and the relatively low electrical conversion efficiency achieved by conventional diesel power plants.

Space Heating: Approximately 65% of remote community space heating demand occurs in the residential sector. Nationally, there is significant uniformity in the residential housing stock. There is widespread recognition by both residents and agencies serving these communities of the pressing need for both energy efficiency and structural design improvements. Fuel oil and wood are the predominant sources of residential space heat; each accounts for approximately 50%.

The institutional sector accounts for approximately 25% of the space heating demand in remote communities; within this sector, educational facilities are the largest user. The commercial sector accounts for the remainder of space heating demand. In both the institutional and commercial sectors, fuel oil is the predominant energy source for space heat.

Power Generation: With the exception of approximately 5 small hydro developments, all remote community power is currently diesel generated. The responsibility for design, equipment, installation, operation and maintenance costs is determined by the "status" of the community served. In "Status Indian" communities the federal government usually assumes the initial design, equipment and installation costs and the provincial/territorial utility assumes ongoing operation and maintenance costs. In non-native communities, all costs and responsibilities are normally assumed by the provincial/territorial utility. A limited number of private interests operate their own diesel power systems.

Energy and cost savings can be realized in remote communities by improving building energy efficiency and by implementing alternative power generation technologies.

Valuable lessons can be learned from projects across Canada which have demonstrated these technologies.

2. OPTIONS

The major technologies and techniques which are being pursued within the remote sector can be divided into 3 groups:

- **Building Energy Efficiency**
  - energy demand in existing residential and institutional/commercial buildings can be significantly reduced through weatherstripping, caulking, increased insulation levels and in some cases, replacement of doors and windows or a complete building re-wrap (exterior insulation);

- energy demand in new buildings can be dramatically reduced by constructing them to higher standards of energy efficiency (e.g., R-2000 standards) and by incorporating mechanical ventilation systems.

- **Space Heating Systems**

  - waste heat, particularly from diesel power and refrigeration plants, can be captured and used to provide space and/or water heat in the same or adjacent facilities;

  - conventional oil-fired heating systems can be supplemented or replaced by heating systems using wood;

  - the efficiency of existing oil-fired furnaces can be improved through proper tuning and/or addition of retention head burners or replacement by new high-efficiency models.

- **Alternative Electricity Generation**

  - small hydro or wood-fired power plants can, under favourable site conditions, provide an alternative to diesel power plants;

  - wind turbine systems can, under favourable site conditions, be connected to a diesel power plant, provide a portion of the total electrical demand and thereby reduce diesel fuel consumption and costs. Stand-alone wind turbine applications are more restricted due to the intermittent availability of wind in most areas and the consequent storage requirements.

  - photovoltaic and intermittent charge diesel systems can provide power for certain low wattage applications such as radio repeater stations.

  - efficiency of the system can be improved through load management and other means.

3. CREDA DEMONSTRATIONS

The CREDA demonstration projects outlined below not only provide tangible evidence of the very significant energy cost savings that can be realized in remote applications. They also describe practical experiences of installing and operating these new technologies under the unique and particularly demanding conditions in a variety of remote settings. The CREDA demonstration projects contained in this **ENEROPTIONS** package are:

- **Building Energy Efficiency**

YUK 20 Senior Citizen Residential Retrofit Program - Throughout Yukon

90 senior citizen homes and apartments received an energy audit of which 56 homes received retrofit measures carried out by contractors specially trained for the work. Retrofit measures ranged from simple air sealing and heating system tuning to complete building re-wrap, resulting in savings from 10% to 65%.

YUK 21 Skookum Jim Friendship Centre - Whitehorse, Yukon

Ten carpenters from native communities throughout the Yukon were selected to represent their Bands in an eight-month energy conservation training program. Participants received formal classroom training and gained practical experience by retrofitting and renovating a 22-year-old building, the Skookum Jim Friendship Centre. The retrofit reduced the heating bill by over 75% on a unit volume basis. The carpenters then retrofitted over 40 homes in Yukon native communities.

NWT 17 50 New Super Energy Efficient Town Houses - Yellowknife, N.W.T.

50 new town houses were built to R-2000 energy efficiency standards. Features include: southern orientation, high insulation levels, sealed air-vapour barriers, poly electric

boxes, air-to-air heat exchangers, enclosed propane furnace area, triple-glazed windows and insulated crawl space. These units used 75% less energy than conventional town houses.

REC 1 Arenas and Curling Rinks

Energy retrofits in 12 community arenas and curling rinks across Canada saved as much as 55% annually. The range of costs and savings associated with individual measures are detailed.

- **Space Heating Systems**

NWT 12 Lac La Martre School Waste Heat Recovery - Lac La Martre, N.W.T.

An exhaust and jacket water waste heat recovery system was installed on an existing NCPC diesel power plant. The waste heat provides nearly 100% of the space heating requirements of an adjacent 1,800 m^2 school, without affecting the NCPC plant production.

NWT 18 Waste Heat Recovery and Distribution - Snowshoe Inn, Fort Providence, N.W.T.

Jacket water and exhaust waste heat are recovered from the Snowshoe Inn's diesel electricity generating plant to provide space heat and domestic hot water in the adjoining buildings. Annual savings are estimated at approximately 65%. The owner has also developed an innovative utilidor system for waste heat distribution.

NFLD 12 Whole Tree Chipping for Fuel - Abitibi Price, Grand Falls, Newfoundland

This project demonstrated and evaluated a complete harvesting-chipping-transportation system for the burning of hardwoods as

an alternative to Bunker C oil in a pulp and paper mill. A saving of $86,000 was achieved by replacing 16,071 barrels of oil with wood chips.

NB 68 Harvesting Forest Residue - Repap Miramichi Forest Products, Newcastle, New Brunswick

This project involved the clear cutting of 135 hectares (334 acres) of low quality timber stands. Once marketable wood was removed, all remaining trees and cuttings were chipped on-site using a mobile chipper, forwarder and chip bin and then transported 16 km (10 mi) to a pulp mill for use as hog fuel. Annual savings of over $190,000 were realized from the use of the wood chips and reductions of $13,500 were achieved in preparation costs for the site prior to replanting.

- **Alternative Electricity Generation**

YUK 12 Remote Photovoltaics - Total North Communications, Yukon and British Columbia

Three 75-peak-watt photovoltaic (PV) systems with lead calcium battery storage were installed at three mountain-top locations in the Yukon and northern British Columbia. The PV systems replaced primary battery systems and provide power for "line of sight" VHF repeater stations. Due to its reliability, helicopter time for site visits has been reduced, saving $6,400 per year.

Many other projects applicable to remote areas have been undertaken. Contact your nearest federal or provincial energy office to learn more about nearby projects or those in applications similar to yours.

4. TECHNOLOGIES AND LESSONS LEARNED

Building Energy Efficiency

Payback Period. Energy savings of up to 65% can be achieved through retrofit of existing buildings. The simple payback period for economically sound retrofit measures can vary from as short as a few months to as long as 12 years. Investment in an energy audit prior to the specification of retrofit measures is strongly recommended as a means of ensuring cost-effective results.

Building Code Applications. For some substandard housing, the addition of insulation to the exterior of walls and roofs is deemed to be a "major renovation" by local code officials. Local codes may then require that all household wiring be simultaneously upgraded. Consequently, the total retrofit cost is significantly increased.

Training Model. The Skookum Jim Friendship Centre project (YUK 21) provides a good training model for transferring energy efficient construction skills to remote communities. The approach combines theoretical training, practical experience and certification with actual applications in remote communities. One of the benefits of the project is that course materials, specially adapted for remote native communities, is now available.

Super Energy Efficient Housing. Super energy efficient housing, which uses about 75% less energy than conventional buildings, can be built economically and practically in remote Northern Canada. Payback periods under four years appear possible. It should be noted that humidity control and the performance of heat recovery ventilators in severe weather may be problems.

Space Heating Systems

Waste Heat. Waste heat, recovered from diesel generating plants, can provide a reliable source of space and domestic hot water heating without adverse impacts on power production. The economic attractiveness of each potential application requires separate analysis and will be determined by factors such as size of heating load, electrical/heat load match, distance between diesel plant and load, and compatibility with the existing heating plant. Waste heat recovered from arena or store refrigeration plants can be a reliable and cost-effective source of space heat and/or domestic hot water.

Wood-Fired Systems. All space heating and hot water needs of remote community schools and water treatment plants can be met reliably and economically by wood-fired systems provided that local wood resources are adequate. Local jobs are created and in comparison to oil, fuel cost savings of up to 75% can be realized.

Operator Support. When installing commercial/institutional wood-fired heating systems in remote settings, it is particularly important to provide suitable operator training and technical support during the start-up phase. Relatively small problems are exacerbated by the general lack of parts and trained service personnel and by the time delays and increased costs associated with an isolated location. This applies to both the heating and wood fuel supply systems.

Wood-Chip Storage. During the design stage, particular attention should be given to the mechanics of the wood-chip storage bin. There have been recurring chip bridging problems with the hydraulic "live bottoms" in several installations though the BDP BCR/UKAF Bin-Feeder solves most problems at lower first and operating costs than equivalent systems.

Alternative Electricity Generation

Opportunities for the implementation of alternative power generation technologies are first determined by the local availability of a suitable alternative or renewable resource.

Wood Resources. Wood resources are accessible to many remote communities, although in some communities further study is required to determine if the available volumes of wood are sufficient to meet power generation requirements.

Photovoltaic Systems. PV power systems for remote radio repeater stations are a reliable and highly cost-effective substitute for conventional battery systems. The primary source of cost savings is reduced maintenance. The simple payback period can be less than 2 years even based on the present relatively high cost of PV systems.

Wind Resources. Wind resources appear most promising in the east and west coastal areas, around Hudson and James Bay and on some Arctic islands. Finding wind machines rugged enough to operate reliably in these harsh environments has been a problem.

Small Hydro. Potential micro and small hydro sites have been identified across all regions. The attractiveness of the economics is often a problem.

Peat. Peat resources have not yet been well documented but are considered to be relatively widely available. Harvesting techniques and costs are not yet well developed for application on a remote community scale.

Coal. Identified coal resources are restricted primarily to the Yukon and N.W.T.

5. NEXT STEPS

Should you wish to pursue a similar initiative to those outlined above or discussed in greater detail in the ENEROPTIONS Case Studies enclosed, "next steps" are suggested below.

- **Existing Buildings**

  - Invest in an energy audit before specifying the retrofit measures to be carried out. The "Resources Available" section (below) presents several available options for securing an energy audit. Depending on your circumstances, the cost for this service can be minimal. As previously emphasized, the benefits, in terms of financial return, can be significant.

  - After carefully identifying the retrofit measures and/or heating system changes which are most advantageous to you, obtain cost quotations from at least two or three experienced and qualified contractors. The experience from the demonstrations contained in this **ENEROPTIONS** package will be a valuable asset. Further contractor selection assistance is available from some of the "Resources Available" listed in the following section of this overview.

- **New Buildings**

  - Ensure that you are thoroughly familiar with super energy efficient building standards; shop carefully for a list of qualified and experienced architects and builders.

- **Alternative Heating and Power Generation Systems**

  - Contact experienced engineering firms for information on applicability, design and cost assessment.

6. RESOURCES AVAILABLE

Free technical reports are available for most of the CREDA projects listed above. Addresses of appropriate contacts for follow-up, including equipment suppliers and system designers, are listed at the end of each of the attached ENEROPTIONS Case Studies under the "Further Information" section.

The departments or ministries of energy in each province or territory have information on energy conservation and alternative energy and may have assistance programs. Check your telephone directory for appropriate contact people.

The Conservation and Renewable Energy Offices (CREOs) of Energy, Mines and Resources Canada in each province and territory have information on remote community demonstrations, and other assistance programs. Check the file folder for the office in your area.

Energy audit services are also available from qualified engineering firms. Information on these firms and the "Recommended Procedure for the Selection of an Engineer to Provide Professional Services" can be obtained from:

(a) The Association of Consulting Engineers of Canada
Suite 616
130 Albert St.
Ottawa, Ontario
K1P 5G4
(613) 236-0569

(b) The Consulting Engineering Organization in each province.

Experienced engineering consulting firms can provide specialized services in the assessment, design and installation of alternative space heating and power generation systems.